

RESEARCH ARTICLE

Rise in higher education researchers and academic publications [version 1; peer review: 2 approved]

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Abstract

Background: How many higher education researchers are there in the world? How many academic articles are published by researchers each year? This paper aims to answer these two questions by tracking the number of higher education teachers and the number of publications over the past four decades.

Methods: We collected data on the number of higher education institutions and researchers from the United Nations, the World Bank, and the U.S., China, and U.K. governments (three countries with the largest number of academic publications in recent years). We used Scopus to obtain the number of publications per year. The growth of higher education researchers and academic publications were characterized using 4-parameter logistic models.

Results: The number of higher education teachers-cum-researchers increased from 4 million in 1980 to 13.1 million in 2018 worldwide. Concurrently, the number of academic publications increased from 0.65 million in 1980 to 3.16 million in 2018 based on data from Scopus. At the country level, the number of academic publications from the U.S. increased from 0.15 million in 1980 to 0.70 million in 2018, while that from China increased by almost 1,000 times from 629 in 1980 to 0.60 million in 2018.

Conclusions: The number of higher education researchers would reach 13.6 million and they would publish 3.21 million academic articles in 2020, imposing enormous pressure to publishers, peer-reviewers, and people who want to understand emerging scientific development. Additionally, not all academic publications are easily assessable because most articles are behind pay-walls. In addition, unethical research practices including falsification, fabrication, plagiarism, slicing publication, publication in a predatory journal or conference, etc. may hinder scientific and human development.

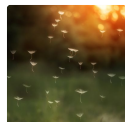
Keywords

Education, Higher education researchers, Academic publications, Global- and country-level analyses, Logistic growth model

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Introduction

The expansion of the higher education sector has been considered as an effective way to build human capital that enhances national competitive advantage (Schofer & Meyer, 2005). Hence, governments all over the world have adopted different strategies and programs to grow the higher education sector in the past few decades. A number of European countries, such as Belgium, Finland, Netherlands, Norway, Germany, and the U.K., have upgraded vocational institutes and polytechnics to universities since the 1980s (Teichler, 1996; Timmermans & Geerdink, 2016). Some countries, such as those in the Middle East and China, have decided to build new universities from the ground up since the millennium (Rupp, 2009), while other countries/cities, such as Argentina, Brazil, Chile, South Korea, Malaysia, Taiwan, Hong Kong and Macao, on top of building new public universities and upgrading polytechnics to universities, have encouraged the private sector to offer quality higher education (McCowan, 2004; Mollis & Marginson, 2002; Ziguras, 2003). Hence, the number of students, the number of institutions, and the number of teachers in the higher education sector have increased continuously.

Specifically, the role of higher education teachers is not only to impart knowledge and skills to students. Higher education teachers are also expected to conduct research that contributes to the creation of new knowledge and insights. Nevertheless, three or four decades ago, many teachers in higher education institutions such as polytechnics and vocational institutes or in the fields of arts and humanities seldom published articles in peer-reviewed academic journals (Altbach, 1977; Scott, 1983). Nowadays, higher education teachers are actively engaging on scholarly or scientific work and sharing their findings through publications. The term “publish or perish” is more real than most higher education teachers might want to admit (Ding, 2001; Génova & de la Vara, 2019; Nabout *et al.*, 2015; Qiu, 2010). It is not unusual that a higher education teacher with a large number of publications can have a better chance for promotion and tenure (Baccini *et al.*, 2014; Hicks *et al.*, 2015; Sandy & Shen, 2019). It will be easier for him/her to obtain research grants and resources (Hicks *et al.*, 2015). Moreover, the advent of information and communications technology enables higher education teachers to conduct research around the clock and at any place (Waltman *et al.*, 2011). Information and communications technology also allows higher education teachers to collaborate with researchers at other institutions and improves the workflow of publishing. Because of that, higher education teachers have assumed a role as academic researchers (sometimes active researchers) and the number of academic publications has increased rapidly in the past decades. Ioannidis *et al.* (2018) in a commentary in *Nature* reported that hundreds if not thousands of scientists publish a paper every five days. Yet, two questions remain unanswered. How many higher education researchers are there in the world? And how many academic articles are published by researchers each year?

The objective of this paper is to answer these two questions that are of importance to the development and management of ‘higher education researchers’, ‘academic publications’, and ‘sound

science.’ Understanding the evolving landscape of academic research can shed light on the rate at which academic publications will grow, and issues in publishing, such as predatory publishing, retractions due to academic dishonesty, etc., may arise (Qiu, 2010).

Methods

Publication and teacher data

Global data were obtained from reports and websites of the World Bank (2000) and UNESCO (2019a); UNESCO (2019b). At the country level, higher education statistics were obtained from the U.S. Department of Education (2019), the National Bureau of Statistics of China (2019), and the U.K. Higher Education Statistics Agency (2019). The U.S., China, and the U.K. were selected because they have been ranked as the top three countries producing the largest number of academic publications since 2004 (Erfanmanesh *et al.*, 2017).

Figures of the number of publications at the global- and country-level during the period 1980–2018 were obtained from Scopus on 1 January 2020, similar to other bibliometric studies in different fields (Kakouris & Georgiadis, 2016; Ma *et al.*, 2019). Scopus was selected as the source of data because it provides a more comprehensive coverage than Web of Science (Jonkers *et al.*, 2014; Kulkarni *et al.*, 2009; Waltman, 2016; Wiles *et al.*, 2013). Currently, Scopus covers >21,500 peer-reviewed journals, >83,000 conference events, >530 book series, and >120,000 books. In addition, Scopus’ article selection criteria are more rigorous than Google Scholar (Kulkarni *et al.*, 2009; Wiles *et al.*, 2013; Wolfenden *et al.*, 2016), thus excluding publications in predatory journals and conferences. Kulkarni *et al.* (2009) and Wiles *et al.* (2013) reported that Scopus has greater data and analysis accuracy than Google Scholar.

To be more precise, annual publication data for the period 1980–2018 were obtained from Scopus by searching the period in question and “0* OR 1* OR 2* OR a*” in “All fields”. Different combinations of keyword search such as “1* OR 2* OR a* OR b*” in “All fields”, “1* OR a* OR b* OR c*” in “All fields”, etc. were tried and almost identical results were obtained. By selecting a particular year using “Filter”, the numbers of publications from different countries in that particular year were obtained.

Prediction modelling

Like all other human endeavors, higher education evolves through different phases. In the emergent phase, the number of institutions, the number of teachers in the world’s higher education sector, and the number of academic publications increased steadily. The numbers increased more and more rapidly when more countries realized that the expansion of the higher education sector could improve national competitive advantage and when these countries had resources. At a certain time, the growth of each of these numbers reached an inflexion point. The growth would then slow down until it reaches the saturation. This S-shaped curve is known as the logistic growth curve (Rogers, 2003). The logistic growth curve has been applied to the adoption of ideas, products, services, management systems, and international trades

(Bass, 2004; Rogers, 2003; To & Lee, 2014; To & Lee, 2018). A typical 4-parameter logistic curve is expressed by Equation (1).

$$N(t) = N_{\text{initial}} + \frac{N_{\text{increase}}}{1 + e^{-\tau(t-t_{\text{mid}})}} \quad (1)$$

where $N(t)$ is the value of the variable at time t , N_{initial} is the initial value, N_{increase} is the total net increase in the value of the variable, τ is a growth constant, and t_{mid} is the time having the maximum rate of growth.

Retraction data

No matter how hard researchers meticulously craft their studies and their manuscripts, peer-reviewers help safeguard the quality of publications, and publishers try to ensure that the authors follow best publication practices, including research ethics and reporting standards, it is inevitable that researchers, peer-reviewers, and publishers can commit mistakes, leading to retractions of published articles. Steen *et al.* (2013) examined the number of publications and retractions indexed in PubMed during the period 1973–2011. They identified 2,047 retracted articles and found that the number of retracted publications has risen sharply and publishers have taken quicker action to retract flawed papers in recent years. Retractions were found due to “fraud” including fabrication, falsification, plagiarism, duplicate publication, etc. and “error” such as publisher error, scientific error, etc. Steen *et al.* (2013) reported that the retraction rate was 0.4 per 10,000 publications between 1973 and 2011 on average based on PubMed’s records. Brainard & You (2018) explored the rise of retracted papers using the Retraction Watch Database. They reported that the number of retractions per year increased rapidly after 1997 but seemed leveling off after 2012 at around 4 out of 10,000 publications per year. Brainard & You (2018) indicated that plagiarism and duplication of text became the major cause of retractions at around 35% of all retractions in the past decade. We followed Brainard & You’s (2018) approach to explore the growth of retractions using Retraction Watch Database – provided by Oranksky and Marcus in the blog Retraction Watch.

Results

Global trend of higher education’s expansion

According to the World Bank (2000) and UNESCO (2019a); UNESCO (2019b), the number of higher education students in

the world was 50 million in 1980, 68 million in 1990, 99 million in 2000, 181 million in 2010, and 224 million in 2018. Concurrently, the number of higher education institutions has quadrupled to around 20,000, while the number of higher education teachers has increased from 4 million in 1980 to 13.1 million in 2018 (The UNESCO, 2019b). Figure 1a shows the number of higher education students and the number of higher education teachers from 1980 to 2018 worldwide. In terms of student-teacher ratio, the world’s average ratio changed from 12.6:1 in 1980 to 17.1:1 in 2018.

Figure 1b shows the number of the world’s higher education teachers and the number of academic publications (including journal articles, conference papers, reviews, letters/notes/editorials, and book chapters) based on the results from Scopus as at 1 January 2020. It shows that the number of academic publications increased from 0.66 million in 1980 to 2.85 million in 2015. The number of academic publications further increased to 3.16 million in 2018. As the great majority of academic publications are authored or co-authored by higher education teachers, the number of publications per higher education teacher was approximated by dividing the number of publications by the number of higher education teachers in that year. This figure increased from 0.164 publications per higher education teacher-cum-researcher in 1980 to 0.242 publications per higher education teacher-cum-researcher in 2018. Still, 3.16 million publications per year was a huge figure, meaning that on average 8,666 publications were published a day in 2018. As the median acceptance rate of journals was around 25% (Sugimoto *et al.* 2013), there were around 34,600 articles submitted to the journals covered by Scopus for peer review every day in 2018.

Country-level analysis: The U.S., China, the U.K.

According to the data obtained from Scopus as at 1 January 2020, the three countries that produced the highest percentage of academic publications in 2018 were the U.S. (22.0%), China (19.1%) and the U.K. (6.8%). Table 1 shows the top 10 countries producing the largest number of academic publications in 1980, 1990, 2000, 2010, 2015, and 2018. Table 1 indicates that the U.S. has always been the top country in the past four decades while the U.K. had been the second country producing the largest number of publications from the 1980s to the early 2000s.

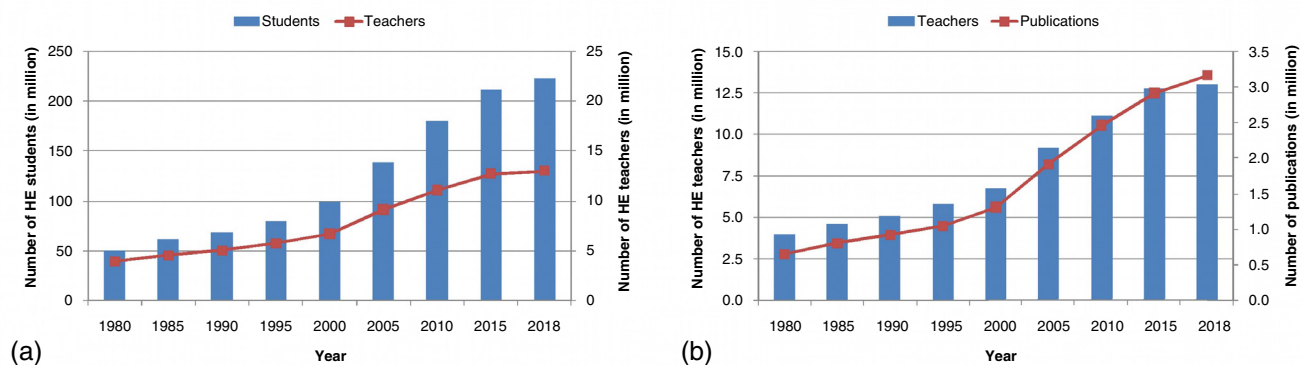


Figure 1. The number of the world’s higher education students, teachers and publications per year from 1980 to 2018. (a) Students and teachers; (b) teachers and publications.

Table 1. Top ten countries producing the largest number of publications in 1980, 1990, 2000, 2010, 2015, and 2018.

Rank	1980		1990		2000		2010		2015		2018	
	Country	Publications ('000)	Country	Publications ('000)	Country	Publications ('000)	Country	Publications ('000)	Country	Publications ('000)	Country	Publications ('000)
1	U.S.	152	U.S.	274	U.S.	374	U.S.	609	U.S.	675	U.S.	695
2	U.K.	40	U.K.	67	U.K.	107	China	344	China	460	China	601
3	Japan	34	Japan	65	Japan	105	U.K.	176	U.K.	202	U.K.	215
4	Germany	33	Germany	51	Germany	91	Germany	154	Germany	175	Germany	184
5	France	22	France	37	France	64	Japan	130	India	142	India	175
6	Canada	16	Canada	32	China	52	France	109	Japan	128	Japan	134
7	Italy	15	Italy	28	Canada	46	Canada	92	France	122	France	123
8	Australia	10	Australia	16	Italy	45	Italy	87	Italy	113	Italy	122
9	India	10	Netherlands	16	Russia	35	India	81	Canada	106	Canada	113
10	Netherlands	7	India	15	Spain	31	Spain	74	Australia	96	Australia	106

Note: China was ranked 39th in 1980 with 629 publications; it was ranked 13th in 1990 with 11,211 publications.

China's ranking has been boosted by its publication outputs that were doubled or quadrupled every four or five years between 1980 and 2010. Figure 2 shows the increasing number of publications from different countries of the world during the period 1980–2018. The spatial-temporal change in the number of publications closely resembles the adoption of good management practices such as ISO 14001 environmental management system standard (see Figure 10 of To & Lee's (2014) study) and change in economic development of countries.

The U.S.

The number of higher education institutions in the U.S. increased from 3,152 in 1980 to 4,298 in 2018 (The U.S. Department of Education, 2019). Among these 4,298 institutions in 2018, there were 2,818 institutions offering 4-year bachelor programs and 1,480 offering two-year programs, respectively. The number of higher education institutions offering 4-year bachelor

degrees or higher is shown in Figure 3a. The number of faculty i.e. teachers in higher education institutions offering 4-year bachelor or higher degree programs, increased from 0.49 million in 1980, to 0.72 million in 2000, and then to 1.21 million in 2018 as shown in Figure 3b. In terms of academic publications, there were 0.15 million academic articles from the U.S. in 1980. The number of academic articles from the U.S. increased to 0.70 million in 2018 as shown in Figure 3c.

China

The number of higher education institutions was 675 in 1980, increasing to 1,016 in 1985. Between 1985 and 2000, the number of higher education institutions was around 1,000–1,100. Since 2001, the number of higher education institutions in China has increased around 100 per year to 2,663 in 2018 (The National Bureau of Statistics of China, 2019). Concurrently, the number of higher education teachers increased from 0.25 million in

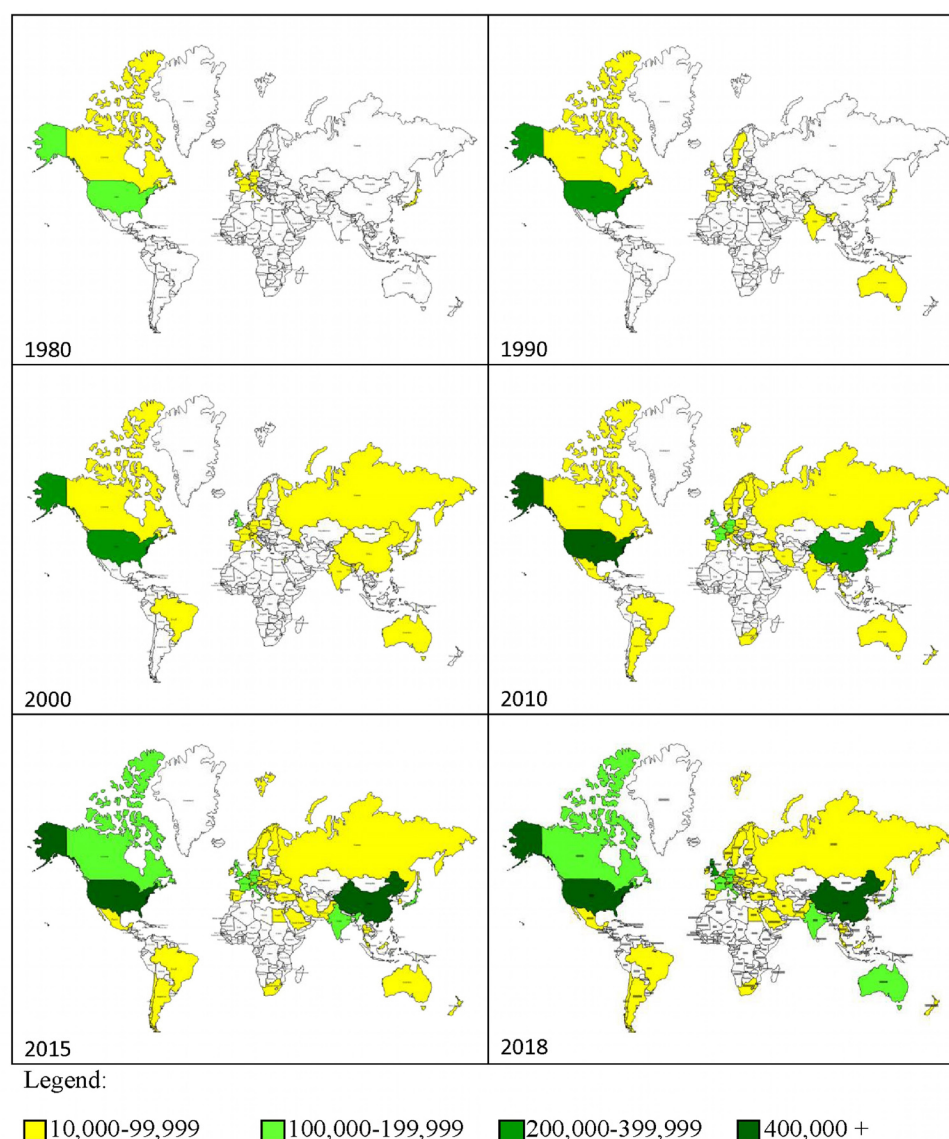


Figure 2. The number of publications from different countries in 1980, 1990, 2000, 2010, 2015, and 2018.

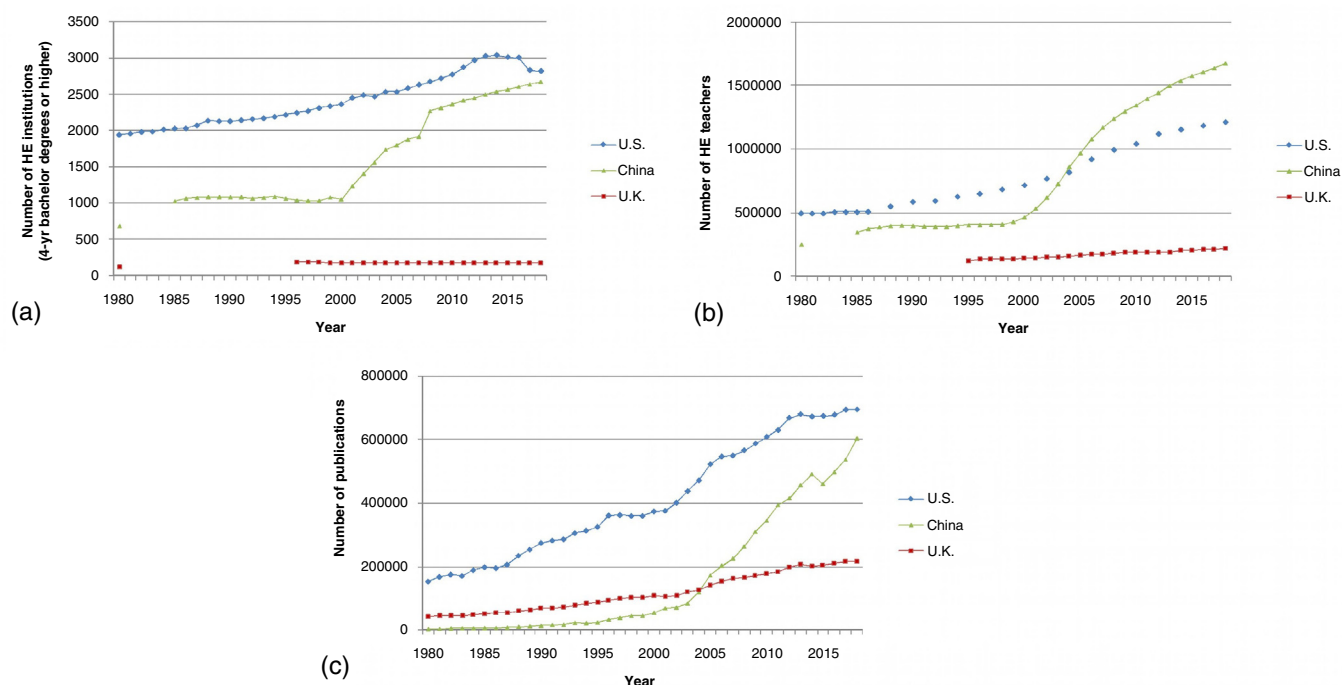


Figure 3. The number of higher education institutions, teachers/researchers and publications from the U.S., China, and the U.K. during the period 1980–2018. (a) Institutions; (b) teachers/researchers; (c) publications (from Scopus as at 1 January 2020). [Notes: The U.S. Department of Education provided biannual data after 1986. No data were available from the National Bureau of Statistics of China for the period 1981–1984 and from the U.K. Higher Education Statistics Agency for the period 1980–1995.]

1980 to 0.46 million in 2000, then to 1.67 million in 2018. The number of academic articles from China increased from 629 in 1980, to 0.05 million in 2000, and then to 0.60 million in 2018.

The U.K.

During the period 1980–2018, the number of higher education institutions in the U.K. increased from 108 (including 25 university colleges of London and Wales) to 165 (The U.K. Higher Education Statistics Agency, 2019). In particular, the number of U.K. universities greatly increased in 1992 due to the passage of the Further and Higher Education Act (Pratt, 1997), in which 38 polytechnics and Scottish vocational institutes were allowed to take the university title. The number of higher education teachers increased from 0.11 million in 1995 to 0.21 million in 2018 while the number of academic articles increased from 0.08 million in 1995 to 0.21 million in 2018. In 1980, the number of academic articles from the U.K. was 40,448.

Publication-teacher ratio

The number of publications has been used as a key measure of academic productivity (Boudreaux *et al.*, 2019; Durieux & Gevenois, 2010; Goldstein, 1979; Kim *et al.*, 2019; Symonds *et al.*, 2006; Waltman *et al.*, 2013), even though it does not necessarily reflect the quality or impact of the outputs (Boudreaux *et al.*, 2019; Durieux & Gevenois, 2010; Waltman *et al.*, 2013). Hence, researchers have proposed other parameters such as h-index (Hirsch, 2005), g-index (Egghe, 2006), and a family of i-indices

(Marchant, 2009) to serve as proxy indicators that cover the quantity and quality of academic publications. Nevertheless, the number of publications is still a common indicator for ranking universities and country's research outputs (Aguillo *et al.*, 2010). The number of publications per teacher was determined for the period 1995–2018, in which figures of the number of higher education teachers were available for the U.S., China, and the U.K. Figure 4 shows the publication-teacher ratio for the year 1998, 2008, and 2018. It shows that the publication-teacher ratio improved from 0.527 in 1998 to 0.571 in 2008 in the U.S. The figure stayed about the same from 2008 to 2018. The publication-teacher ratio was 0.105 in 1998 in China. The figure improved to 0.212 in 2008, then to 0.362 in 2018. The U.K. had the highest publication-teacher ratio at 0.778 in 1998. This figure increased to 0.943 in 2008, then to 1.013 in 2018.

The growth of higher education teachers-cum-researchers

The expansion of the higher education sector will continue in the foreseeable future. Figure 5 shows the number of higher education teachers-cum-researchers for the period 1980–2015 using a bar chart format. It was observed that the number of higher education teachers-cum-researchers increased quite steadily from 1980 to the late 1990s, then more rapidly from the late 1990s to 2010. After 2010, the increase in the number of higher education teachers-cum-researchers started flattening out. This phenomenon is expressed by the following 4-parameter logistic equation.

$$NR(t) = NR_{initial} + \frac{NR_{increase}}{1 + e^{-\epsilon_{NR}(t - t_{mid})}} \quad (2)$$

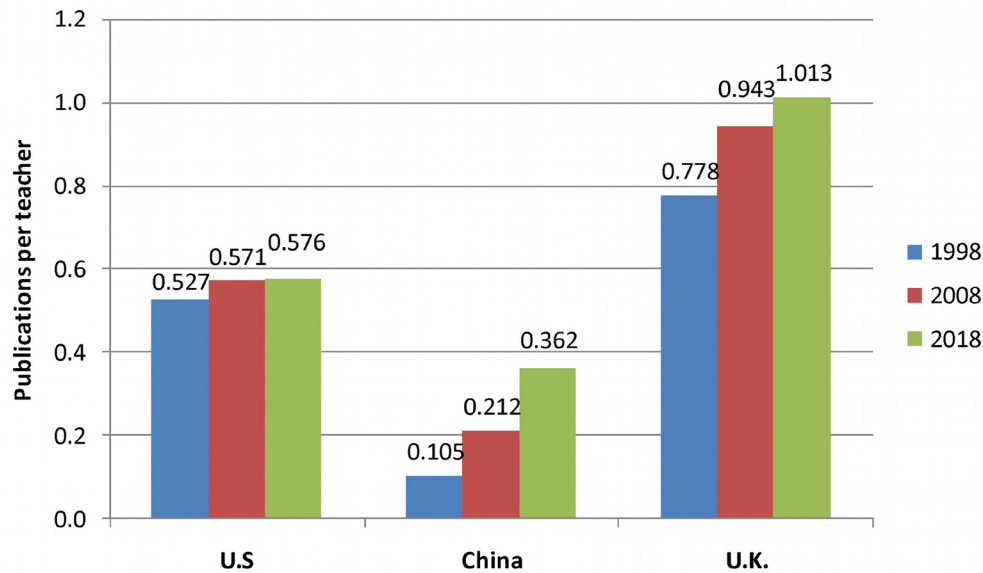


Figure 4. Publication-teacher ratios in the U.S., China, and the U.K.

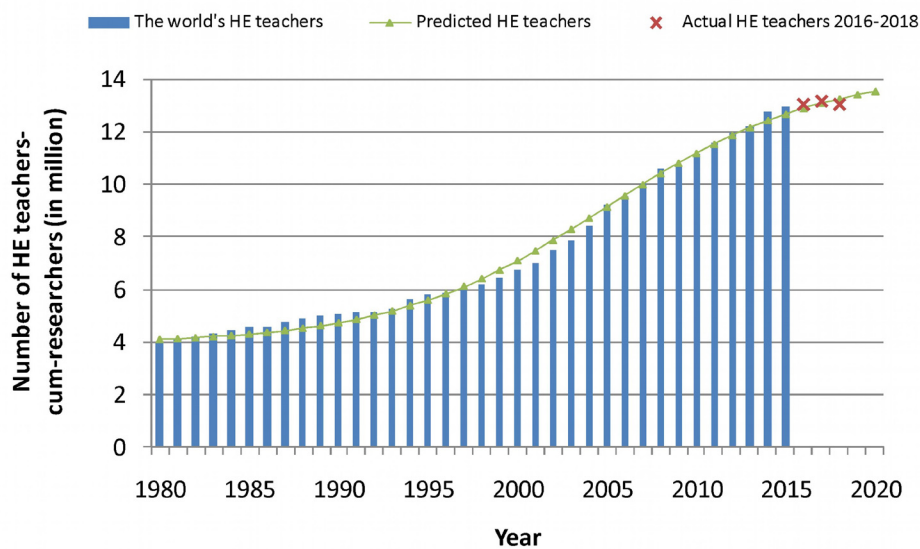


Figure 5. The number of the world's higher education teachers-cum-researchers from 1980 to 2015 and the predicted value from 1980 to 2020.

where $NR(t)$ is the number of higher education teachers-cum-researchers at time t , $NR_{initial}$ is the initial value, $NR_{increase}$ is the total net increase in the number of higher education teachers-cum-researchers, τ_{NP} is a growth constant, and t_{mid} is the time (i.e. year) having the maximum rate of growth. A nonlinear algorithm was applied to the data and it was found that the values of $NR_{initial}$, $NR_{increase}$, τ_{NP} and t_{mid} were 3.95 million, 10.4 million, 0.166, and 2005, respectively. Hence, the number of higher education researchers is given in Equation (3).

$$NR(t) = 3.95 + \frac{10.4}{1 + e^{-0.166(t-2005)}} \quad \text{million,} \quad R^2 = 0.994 \quad (3)$$

The mean absolute percentage error of the logistic growth model was 3.09% for the period 1980–2015. The coefficient of

determination, R^2 , between the actual and predicted values for the period 1980–2015 was 0.994, meaning that 99.4% of variation of the actual number could be explained by the logistic model. Based on the logistic model shown in Equation (3), it was predicted that the number of higher education researchers would increase to 13.6 million by 2020, i.e. another 5.9% increase from the number of higher education researchers in 2015. Using Equation (3), it was projected that the number of higher education teachers-cum-researchers was 12.9 million, 13.1 million, and 13.3 million in 2016, 2017, and 2018 respectively. The actual number of higher education teachers-cum-researchers was 13.1 million, 13.2 million, and 13.1 million in 2016, 2017, and 2018, respectively. The mean absolute percentage error was 1.1% for 2016–2018.

The growth of academic publications

The logistic growth model was also applied to model the number of publications during the period 1980–2015 using a bar chart format. The resulting logistic model is shown in Equation (4).

$$NP(t) = 0.68 + \frac{2.75}{1 + e^{-0.178(t-2006)}} \quad \text{million,} \quad R^2 = 0.994 \quad (4)$$

where $NP(t)$ is the number of publications at time t . The mean absolute percentage error of the logistic growth model was 4.32% for the period 1980–2015. The coefficient of determination, R^2 , between the actual and predicted values for the period 1980–2015 was 0.994. Figure 6 shows the actual and predicted number of academic publications for the period 1980–2015. It was predicted that the number of publications would be 3.03 million, 3.09 million, and 3.14 million in 2016, 2017, and 2018, respectively. As the number of publications was 2.98 million, 3.12 million, and 3.16 million in 2016, 2017, and 2018 according to the Scopus database, the mean absolute percentage error based on Equation (4) for the period 2016–2018 was 1.153%. Thus, it can be concluded that Equation (4) has good predictive capability.

Based on the logistic model shown in Equation (4), it was predicted that the number of academic publications would increase to 3.22 million by 2020, i.e. another 2% increase from the number of academic publications in 2018.

The growth of retractions

Figure 7 shows that the number of retractions and retraction ratio increased almost continuously from 1985 to 2012 and seemed to level off after 2012. Specifically, the number of retractions was 1413, 5082, and 3031 in 2009, 2010, and 2011, respectively. The retraction ratio ranged from 2.4 to 3.9 per 10,000 publications during the period 2012–2018, similar to the findings of Brainard & You (2018). Table 2 and Figure 8 present that the number of retractions and retraction ratio were categorized by country. In fact, there were 126–226 retracted publications per year from the U.S. researchers, 33–4133 retracted publications per year from Chinese researchers and 20–51 retracted publications from the U.K. researchers between 2005 and 2018, respectively. Figure 8 shows that China had the highest retraction ratio among the three selected countries at 4.0 per

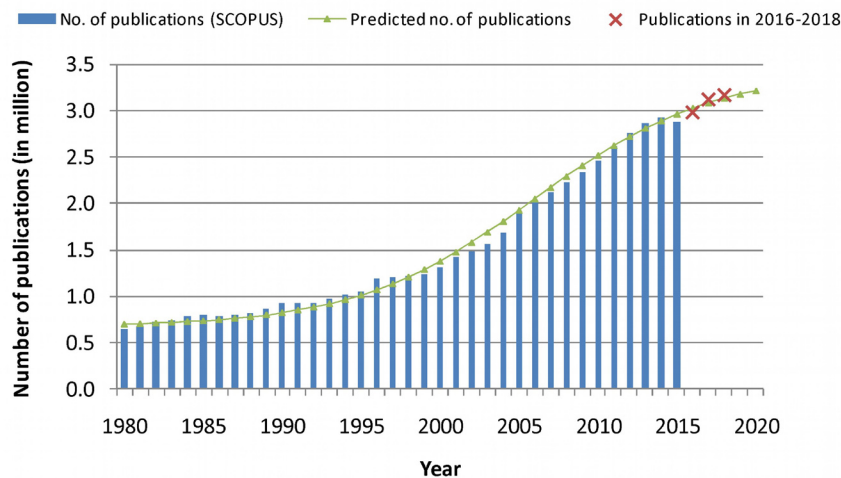


Figure 6. The number of publications from 1980 to 2015 and the predicted value from 1980 to 2020.

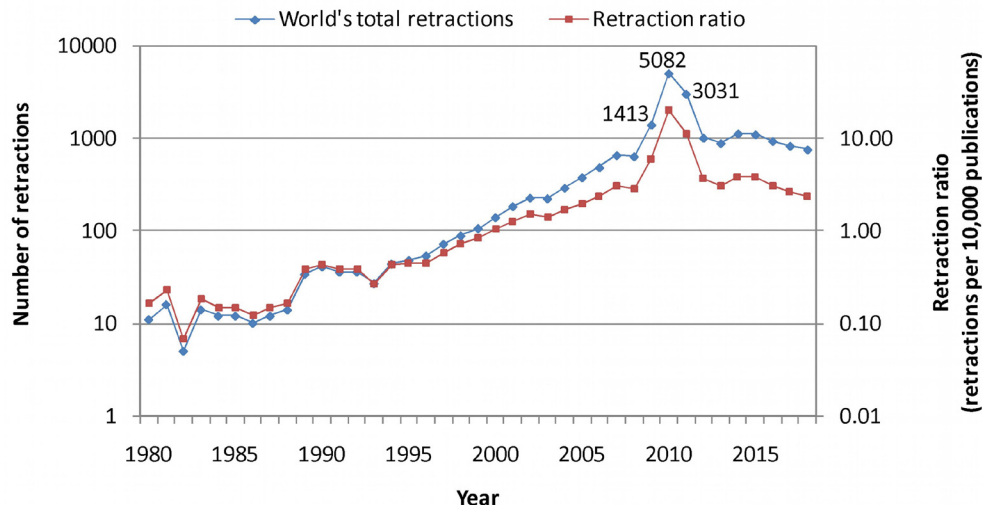
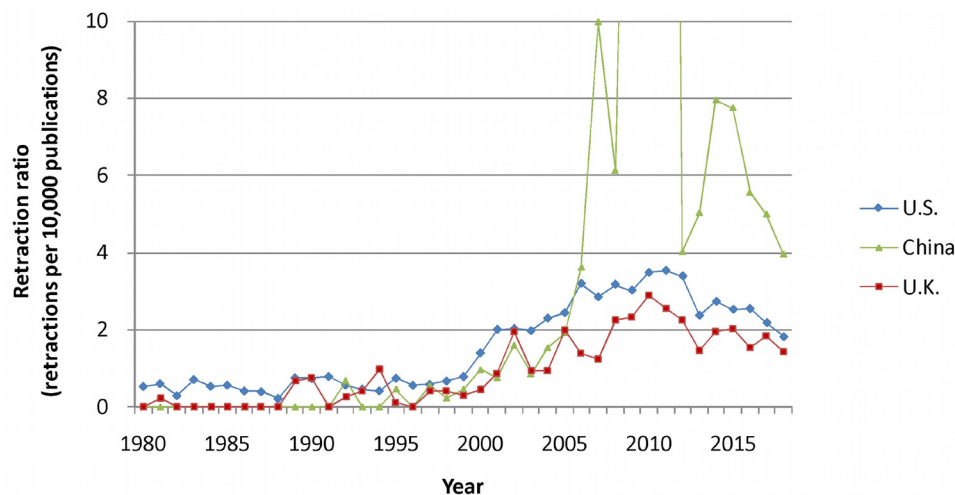


Figure 7. The number of retractions and retraction ratio from 1980 to 2018.

Table 2. The number of retractions (based on Retraction Watch Database on 15 January 2020).

Year	Global-level, i.e. the world's total	Country-level (percent)		
		US	China	UK
1980	11	8 (72.7)	0 (0.0)	0 (0.0)
1985	12	11 (91.7)	0 (0.0)	0 (0.0)
1990	41	20 (48.8)	0 (0.0)	5 (12.2)
1995	48	24 (50.0)	1 (2.1)	1 (2.1)
2000	140	52 (37.1)	5 (3.6)	5 (3.6)
2005	379	127 (33.5)	33 (8.7)	28 (7.4)
2010	5082	211 (4.2)	4113 (80.9)	51 (1.0)
2015	1106	170 (15.4)	357 (32.3)	41 (3.7)
2018	759	126 (16.6)	240 (31.6)	31 (4.1)

**Figure 8.** Retraction ratio by country from 1980 to 2018. [Note: Retraction ratio was 26.4, 119.4, and 56.7 in 2009, 2010, and 2011 by authors in China, respectively.]

10,000 publications, followed by the U.S. at 1.8 per 10,000 publications in the Year of 2018. [McCook \(2018\)](#) reported that massive retractions i.e. over 7,000 retractions were reported by the Institute of Electrical and Electronics Engineering (IEEE). Many of these retractions were from IEEE Conferences during the period 2009–2011 and published by higher education researchers in China ([McCook, 2018](#)), making China's retraction ratio increase to over 10 per 10,000 publications in that period. [Lei & Zheng \(2018\)](#) explored scientific integrity in China based on the retraction notes provided by the Web of Science Database. They reported that misconduct such as fabrication, falsification, plagiarism, and faked peer review contributed to three quarters of retractions.

Discussion

As at 1 January 2020, 109 million people, including many undergraduate students, have registered as members of Academia.edu, over 15 million researchers including higher education

researchers, and researchers in the private and public sectors have registered to Researchgate.com. Just four years ago, Academia.edu had about 30 million registered members ([Niyazov et al., 2016](#)) while Researchgate.com had about 8 million registered members. These figures showed that academic research is valuable and people who are interesting in knowing more about research flock to join academic social networking sites. But actual how many “higher education researchers” are there in the world and what is the productivity of this group of researchers? Both questions warrant a thorough analysis because answers to the questions can help us understand the past, present and future of academic research and the consequences of increase in higher education researchers and academic publications.

This paper shows that there are more than 13 million higher education researchers in the world, and they publish more than 3 million academic articles a year with a mild upward trends. Moreover, the rise of higher education researchers and academic

publications in China has been phenomenal in the past two decades. On one hand, the rise of higher education researchers and academic publications can lead to more innovations and technological breakthroughs (Schofer & Meyer, 2005). On the other hand, there are issues raised such as (i) increasing demand on open access to academic research papers and data, (ii) leading to a greater demand on rapid publications that may jeopardize the quality of peer-reviews and the published research papers, (iii) rising the number of predatory publishers and journals, and (iv) inducing academic flaws such as fabrication, falsification, plagiarism, duplicate publication, slicing publication, stealing from other researchers, etc. (Glänzel *et al.*, 2015). The world's scientific community must work together to resolve or tackle these burning issues (Qiu, 2010). China's research community has learnt hard lessons that have improved academic productivity and maintained research integrity. Specifically, China's Ministry of Science and Technology have strengthened its campaign against research misconducts such as adopting new standards that define all kinds of violations of research integrity and outline the associated penalties since 2019 (Zhang, 2019).

Peer review is also an important issue. As the number of publications grows, the number of peer reviewers increases. Vesper (2018) reported that journal editors invite more and more reviewers, but reviewer acceptance and completion rates were on the decline. Additionally, researchers in the U.S. and the U.K. wrote about two peer-reviews while they submitted one article to a journal, compared with Chinese researchers performing about 0.6 peer-reviews while they submitted one article to a journal. Hence, researchers in China should take a more active role in editorial and review process. Yet, it may not be realistic for a researcher to review a large number of articles while he/she maintains an active role in conducting research, supervising students, and preparing and revising his/her own manuscripts to journals. According to Publons.com, 115 researchers have conducted 183 or above reviews in the last 12 months, i.e. more than one review every two days as at 18 January 2020. Among these

researchers, 15 of them have conducted over 365 reviews in the last 12 months, i.e. one review per day. On one hand, these academics should be praised for their devotion to academic services. On the other hand, how to maintain high-quality, constructive, and thorough reviews from these peer-reviewers has yet to be seen - probably until most academic publishers and journals adopt an open review policy.

Conclusions

We have witnessed the expansion of higher education and the surge of academic publications over the past four decades. Based on the official data from national and international bodies, it was found that the number of higher education teachers-cum-researchers increased by over 3-fold from 4 million in 1980 to 13.1 million in 2018, while most higher education teachers nowadays are active researchers. During the same period, the number of academic publications increased by more than 4-fold from 0.65 million in 1980 to 3.16 million in 2018. The number of higher education researchers and the number of publications worldwide follow a logistic growth curve, and the maximum rate of growth in the number of higher education researchers took place in 2005 while that in the number of academic publications took place in 2006. Moreover, it was projected that the number of higher education researchers would reach 13.6 million and their outputs would reach 3.21 million academic publications a year in 2020.

Data availability

Underlying data

Figshare: Teachers Publications 1980 To 2018.xlsx, <https://doi.org/10.6084/m9.figshare.11648226> (To, 2020a).

Figshare: Publications 1980–2018 By Country.xlsx, <https://doi.org/10.6084/m9.figshare.11692233.v1> (To, 2020b).

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Muzammil Tahira 

Department of Library, University of Education, Lahore, Pakistan

This is a very informative article. It provides a good overview of the rise of higher education researchers and academic articles per year by considering the first three top-rank research productive countries, America, UK, and China. The introduction and discussion are very well written based on authentic reports and data retrieved from prestigious reference enhanced database Scopus. The simple logistic model presentation was found enough to understand the issues of retraction, reasons for the rapid development, peer reviews, demand on open access to academic research papers. The article is well articulated around the research questions and provided a predictive value of emerging research productivity trends and highlighted its consequences. To improve the conclusions section, it is suggested to include a few obvious relations of increase in no. of journals, ICT's facilities, and national and international collaboration with increasing no. of world research productivity and researchers during 1980-2018.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Is the argument information presented in such a way that it can be understood by a non-academic audience?

Partly

Does the piece present solutions to actual real world challenges?

Partly

Is real-world evidence provided to support any conclusions made?

Partly

Could any solutions being offered be effectively implemented in practice?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Research Performance Evaluation (RPE), Scientometrics, Higher Education Institutions, Internet of Things, (IoT), Digital Libraries and Digital Literacy

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

Reviewer Report 06 April 2020

<https://doi.org/10.21956/emeraldopenres.14507.r26666>

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I.A.C. Mok 

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I enjoy reading the paper. In order to track the rise of higher education, the authors address two interesting questions: How many higher education researchers are there in the world? How many academic articles are published by researchers each year?

Global data were obtained from reliable reports and websites of the World Bank and UNESCO; whereas the country level, higher education statistics were obtained from the U.S., China, and U.K. government reports. The statistical method was explicitly explained for validity and reliability. A typical 4-parameter logistic curve was used as a prediction model for the data. The results provided evidence to support the expansion of higher education and the surge of academic publications in the last four decades. Important issues such as retraction, peer reviews, demand

on open access to academic research papers and data, and reasons for the rapid development, were discussed.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Is the argument information presented in such a way that it can be understood by a non-academic audience?

Yes

Does the piece present solutions to actual real world challenges?

Yes

Is real-world evidence provided to support any conclusions made?

Yes

Could any solutions being offered be effectively implemented in practice?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Mathematics education, Teacher education, Education

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.